

SMS# 992652

Fac. ID 8684119

Phase (check one)	Type (check one)
<input checked="" type="checkbox"/> Initial Site Investigation	<input type="checkbox"/> Work Scope
<input type="checkbox"/> Corrective Action Feasibility Investigation	<input checked="" type="checkbox"/> Technical Report
<input type="checkbox"/> Corrective Action Plan	<input type="checkbox"/> PCF Reimbursement Request
<input type="checkbox"/> Corrective Action Summary Report	<input type="checkbox"/> General Correspondence
<input type="checkbox"/> Monitoring Report	

INITIAL SITE INVESTIGATION REPORT

A.G. Anderson Cement Plant
Swanton, VT

A Property Owned By:
A.G. Anderson, Inc.
58 South Main Street
Waterbury, Vermont 05676
(802) 244-7811

Prepared by:
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September 7, 1999

EXECUTIVE SUMMARY

Two 4,000 gallon diesel USTs and one 4,000 gallon gasoline UST were removed from the A.G. Anderson Swanton Cement Plant in Swanton, Vermont on June 28, 1999. Volatile organic compound (VOC) concentrations of over 2,000 parts per million (ppm) were encountered below tank #2 and tank #3 (diesel and gasoline, respectively). As the area around these two tanks was capped with cement to accommodate large trucks, further investigation into the magnitude and extent of contamination could not be performed, and an initial site investigation was performed on July 21, 1999.

This investigation entailed the installation of four temporary monitoring wells, and three permanent monitoring wells. Groundwater flow was calculated to be to the west/northwest, at a gradient of 0.3%. A total of eight groundwater samples and one soil sample were collected for analyses by Green Mountain Laboratories in Middlesex, Vermont. Both EPA Methods 8260 and 8015M were applied, and no compounds were detected above the State of Vermont Groundwater Enforcement Standards. Volatile Organic Compound concentrations were measured with a photoionization detector in the field. A high reading of 35 ppm was detected in MW-2, which is directly downgradient of the removed UST area.

The results of this investigation indicate that low concentrations of hydrocarbon contamination exist in the groundwater below the site. However, as none of these concentrations exceed the Vermont Groundwater Enforcement Standards, active remediation is currently not warranted. Quarterly groundwater monitoring is recommended, however, and should begin in October 1999.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
1.0 INTRODUCTION / SITE HISTORY	4
2.0 METHODOLOGY	4
2.1 Soil Boring Investigation	4
3.0 RESULTS	5
4.0 CONCLUSIONS / RECOMMENDATIONS	7

1.0 INTRODUCTION / SITE HISTORY

The A.G. Anderson Swanton Cement Plant is located on the corner of First and Elm Streets in Swanton, Vermont (see attached Site Location Map). On June 28, 1999, I oversaw the removal of two 4,000 gallon diesel USTs and one 4,000 gallon gasoline UST at the property. Northland Petroleum of Barre, Vermont removed the tanks, which were cleaned and transported to Hodgdon Bros. Salvage. Volatile organic compound (VOC) concentrations of over 2,000 parts per million (ppm) were encountered below tank #2 and tank #3 (diesel and gasoline, respectively). As the area around these two tanks was capped with cement to accommodate large trucks, further investigation into the magnitude and extent of contamination could not be performed. All soils were backfilled into the excavation, and a Site Expressway Notification Form was completed, signed by Mr. Carl Anderson, and submitted by fax to Mr. Chuck Schwer of the Sites Management Section. Approval to proceed was obtained from Mr. Schwer shortly thereafter, and on July 21, 1999 an initial site investigation was performed. This report details the methods and results of that investigation.

2.0 METHODOLOGY

2.1 Soil Boring Investigation

On July 21, 1999 I supervised the installation of four temporary groundwater monitoring wells and three permanent monitoring wells within the front (north) half of the property. Adams Engineering of Underhill, Vermont performed the boring and well installation. A wet core drill and hammer drill were used to break through the heavy, reinforced concrete which covered the area of investigation. Each boring was then advanced using Adam's vibratory rig with a 5 foot stainless steel coring device having a 2 3/8" inside diameter. The sampler was lined with a polyethylene bag, advanced in 5 foot increments into the water table, and then brought up to ground surface where the soils were removed for examination. The soil core was broken into either 1 foot increments or soil type during logging, placed in a freezer bag, and the headspace within the bag was then screened with a photoionization detector (PID) for volatile organic compounds (VOCs). All borings were backfilled with a bentonite plug plus native soil.

When the first three temporary wells were completed (SB-1, SB-2, and SB-3), the top of each well's casing was surveyed relative to an arbitrary datum (100.00 feet) and a groundwater flow direction was calculated. This information was then used in determining the location of the three permanent wells (MW-1, MW-2, and MW-3). A fourth temporary well (SB-4/TW-4) was installed just downgradient of the existing 2,000 gallon gasoline UST that had been closed in place roughly 10 years ago (see site map). Both a groundwater sample and soil sample were collected from this location. The soil sample was collected at the 4.0 - 4.4' bgs area, which was where groundwater was encountered. The three permanent wells were installed "at grade" in locations which surrounded the area which formerly housed tank #2 and #3.

After each temporary and permanent well was installed, they were developed with a peristaltic pump until the flow became non-turbid. A groundwater sample was then collected from each well and delivered to Green Mountain Laboratories in Middlesex, Vermont for EPA Method 8015 and 8020 analyses. The results are included in the attached pages, and they are tabulated below.

Closed
How?

USTs

has no

records of

closure,

interest

needs doing.

3.0 RESULTS

The boring/well locations are shown in the attached site map. Based on the survey performed after installing the first three temporary wells, it was determined that the groundwater flow direction was to the northwest. We therefore installed a well (MW-1) upgradient of the tank removal area, a well directly downgradient (MW-2) and adjacent to the tank removal area, and another well (MW-3) in an off gradient area near the property line. The three wells were surveyed using the same temporary benchmark used with the temporary well survey, and the locations allowed us to triangulate a groundwater flow direction. The soil logs and PID results of each boring are as follows:

<u>Boring</u>	<u>Interval</u>	<u>Recovery</u>	<u>PID Screening</u>	
SB-1	0-5'	No recovery (stones)		
	5-10'	3.0' recovery		
Description	5.0-7.0'	no recovery		
	7.0-10.0'	medium sand, dark gray, old gas odor, moist	7.0-8.0'	12.6 ppm
			8.0-9.0'	9.0 ppm
			9.0-10.0'	4.2 ppm
	10-15'	5' recovery		
Description	10.0-15.0'	medium sand, dark gray, wet	10-11'	2.8 ppm
			11-12'	3.4 ppm
			12-13'	1.4 ppm
			13-14'	1.6 ppm
Set SB-1 (TW-1) at 15' bgs				
	14-15'	1.0 ppm		
<hr/>				
SB-2	0-5'	3.5' recovery		
Description	0-1.5'	no recovery		
	1.5-3.5'	gravelly sand fill, brown, moist	1.5-2.5'	12.4 ppm
			2.5-3.5'	9.8 ppm
	3.5-4.1'	fine sandy loam, dark brown, moist	3.5-4.1'	9.5 ppm
	4.1-5.0'	medium sand, gray, moist	4.1-5.0'	10.0 ppm
	5-10'	4.0' recovery		
Description	5.0-6.0'	no recovery		
	6.0-10.0'	medium sand, dark gray, wet	6.0-7.0'	11.0 ppm
			7.0-8.0'	2.0 ppm
			8.0-9.0'	2.6 ppm
Set SB-2 (TW-2) at 10' bgs				
	9.0-10.0'	2.1 ppm		
<hr/>				
SB-3	0-5'	3.0' recovery		
Description	0-2.0'	no recovery		
	2.0-3.8'	medium to coarse sand, brown, moist	2-3.8'	3.1 ppm
	3.8-4.2'	fine sandy loam, dark a gray, moist, old gas odor	3.8-4.2'	9.2 ppm
	4.2-5.0'	fine to medium sand, grayish brown, moist	4.2-5.0'	11.3 ppm

5-10'	4.0' recovery			
Description	5.0-6.0'	no recovery		
	6.0-10.0'	fine to medium sand, grayish brown, wet	6.0-7.0'	3.3 ppm
			7.0-8.0'	0.8 ppm
			8.0-9.0'	1.0 ppm
			9.0-10.0'	1.0 ppm

Set SB-3 (TW-3) at 10' bgs

SB-4 0 - 5'	3.5' recovery			
Description	0 - 1.5'	no recovery		
	1.5 - 2.6'	medium sand fill, brown, moist	1.5-2.6'	4.0 ppm
	2.6 - 4.2'	loamy fine sand, gray, moist	2.6-4.2'	7.0 ppm
	4.2 - 5.0'	fine to medium sand, dark gray, wet	4.2-5.0'	6.9 ppm

5 - 10'	4.0' recovery			
Description	5.0 - 6.0'	no recovery		
	6.0 - 8.0'	fine to medium sand, dark gray, wet	6.0-7.0'	2.9 ppm
			7.0-8.0'	6.4 ppm
	8.0 - 10.0'	medium sand, dark gray, wet	8.0-9.0'	6.6 ppm
			9.0-10.0'	4.2 ppm

Set SB-4 (TW-4) at 9' bgs

MW-1 0-5'	5.0' recovery			
Description	0-1.7'	medium to coarse sand, light brown, moist	0-1.7'	2.1 ppm
	1.7-2.6'	fine sand, dark gray, moist	1.7-2.6'	3.7 ppm
	2.6-5.0'	fine to medium sand, gray, moist	2.6-4.0'	2.7 ppm
			4.0-5.0'	2.4 ppm

5-10'	4.0' recovery			
Description	5.0-6.0'	no recovery		
	6.0-8.4'	fine to medium sand, dark gray, wet	6.0-7.0'	3.8 ppm
			7.0-8.4'	3.0 ppm
	8.4-10.0	medium sand, dark gray, wet	8.4-9.0'	4.7 ppm
			9.0-10.0'	3.5 ppm

10-13'	3.0' recovery			
Description	10.0-13.0'	medium sand, dark gray, wet	10.0-13.0'	1.6 ppm

MW-2 0-5'	4.0' recovery			
Description	0.0-1.0'	no recovery		
	1.0-2.0'	gravelly sand fill, gray, dry	1.0-2.0'	7.0 ppm
	2.0-2.9'	fine sandy loam, dark brown, moist, old gas odor	2.0-2.9'	35.0 ppm
	2.9-5.0'	fine to medium sand, dark gray, moist	2.9-4.0'	8.7 ppm
			4.0-5.0'	6.2 ppm
5-10'	4.0' recovery			
	5.0-6.0'	no recovery		
	6.0-9.3'	fine to medium sand, dark gray, wet	6.0-8.0'	5.1 ppm
			8.0-9.3'	9.8 ppm
	9.3-10.0'	medium sand, dark gray, wet	9.3-10.0'	7.0 ppm

MW-3	0-5'	4.0' recovery		
Description		0-1.0'	no recovery	
		1.0-1.8'	gravelly sand fill, gray, dry	1.0-1.8' 0.8 ppm
		1.8-3.3'	medium sand, dark gray, moist	1.8-3.3' 2.4 ppm
		3.3-5.0'	loamy fine sand, dark brown, moist	3.3-5.0' 2.1 ppm
	5-10'	3.0' recovery		
Description		5.0-7.0'	no recovery	
		7.0-10.0'	loamy fine sand, dark brown, wet	7.0-8.0' 3.0 ppm
				8.0-9.0' 3.1 ppm
				9.0-10.0' 3.1 ppm

Set well screen from 3' - 8' bgs

4.0 CONCLUSIONS / RECOMMENDATIONS

Although VOC levels encountered during the tank removal were very high (above 2,000 ppm), the contamination does not appear to have migrated substantially from the tank removal area. Temporary and permanent wells were installed in locations surrounding the tank removal area, and the highest VOC concentration measured was only 35 ppm in MW-2 at roughly 2 to 3 feet below ground surface (bgs). MW-2 is located directly downgradient and adjacent to the UST excavation area, and the contamination detected here was expected.

A total of eight groundwater and one soil sample were analyzed by Green Mountain Labs. None of these samples had VOC or TPH concentrations exceeding the Vermont Groundwater Enforcement Standards (GWES).

The lack of exceedingly high VOC concentrations encountered during the investigation may be attributed to very slow groundwater movement (0.3% gradient) in the area. This flat gradient may be attributed to the lack of pumping wells, both municipal and private, in the area. There may also be a gradient connection with the Mississquoi River, which flows within a mile of the site at some points. In addition to the low gradient, a high rate of natural attenuation may be present. Workers at A.G. Anderson have commented that there are nitrogen problems with the shallow groundwater, which they state is one reason for the lack of private wells. However, the groundwater samples were only analyzed for hydrocarbon constituents, and other parameters which may indicate biodegradation (namely reduced iron) were not tested for.

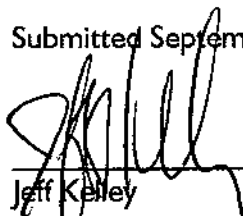
Both the groundwater and soil samples collected from SB-4/TW-4 had relatively low concentrations of total petroleum hydrocarbons (TPH), and VOCs. However, their levels are not high enough to warrant further investigation in the area, especially since SB-3 and MW-2 are located roughly downgradient and would probably intercept any migrating contamination if it were substantial.

Based on the results of this investigation, it appears that active remediation of the site is not warranted. However, the presence of low levels of groundwater contamination indicate a need

for continued groundwater monitoring. Quarterly monitoring will provide ample groundwater quality data that will provide comparisons over seasonal groundwater level fluctuations. In addition to testing for VOCs and TPH (EPA Methods 8020 and 8015M, respectively), it would be appropriate to perform a field test for soluble iron, whose presence indicates subsurface biological activity where dissolved oxygen has already been depleted. A draft copy of John Amadon's 1997 essay titled "A simple field test for subsurface biodegradation" is attached to this report.

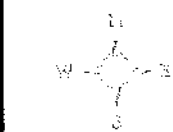
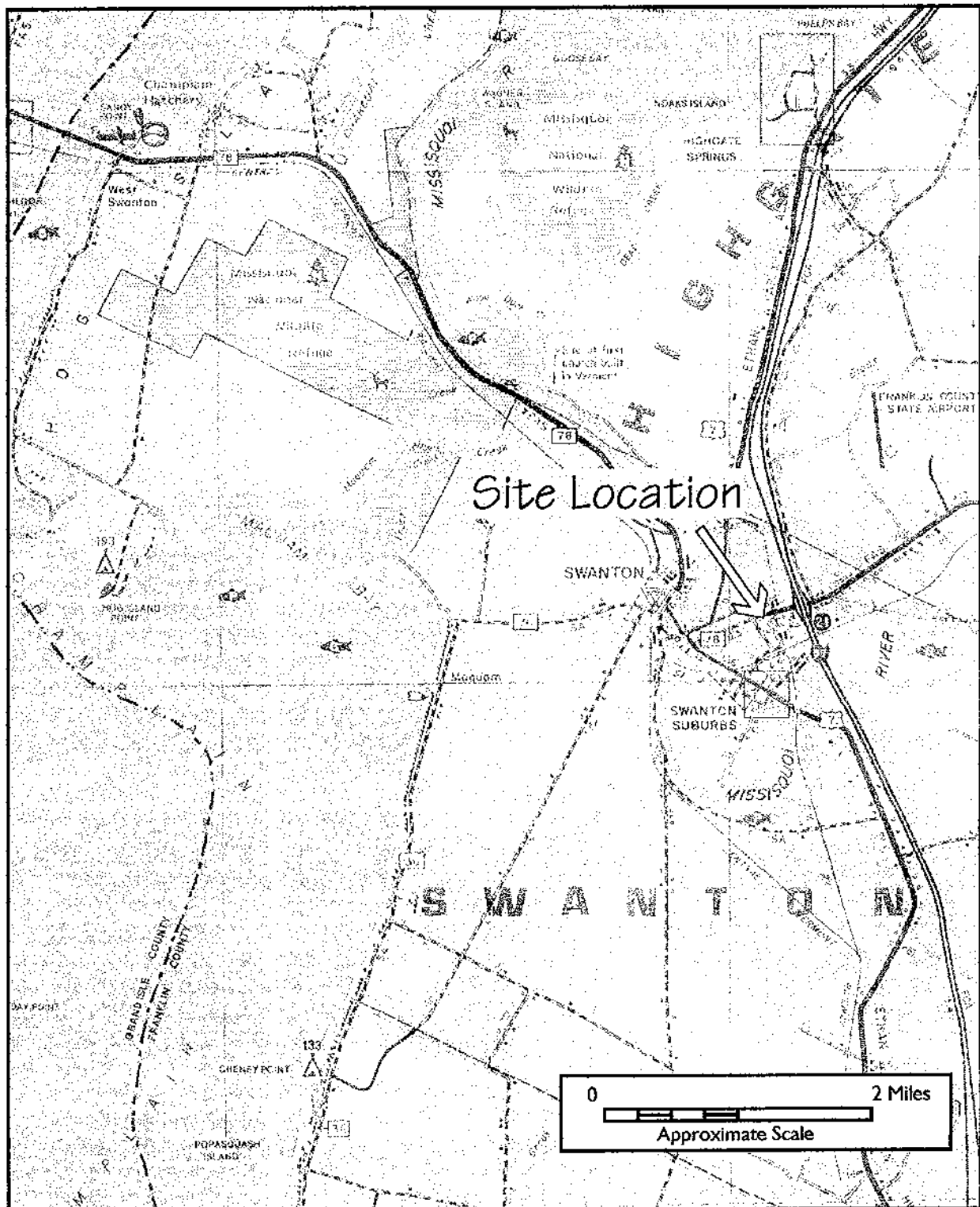
The proposed quarterly sampling should begin in October 1999. Trends in groundwater elevations and quality will be established and discussed in a written report after each sampling event.

Submitted September 7, 1999:



Jeff Kelley
Consulting Geologist

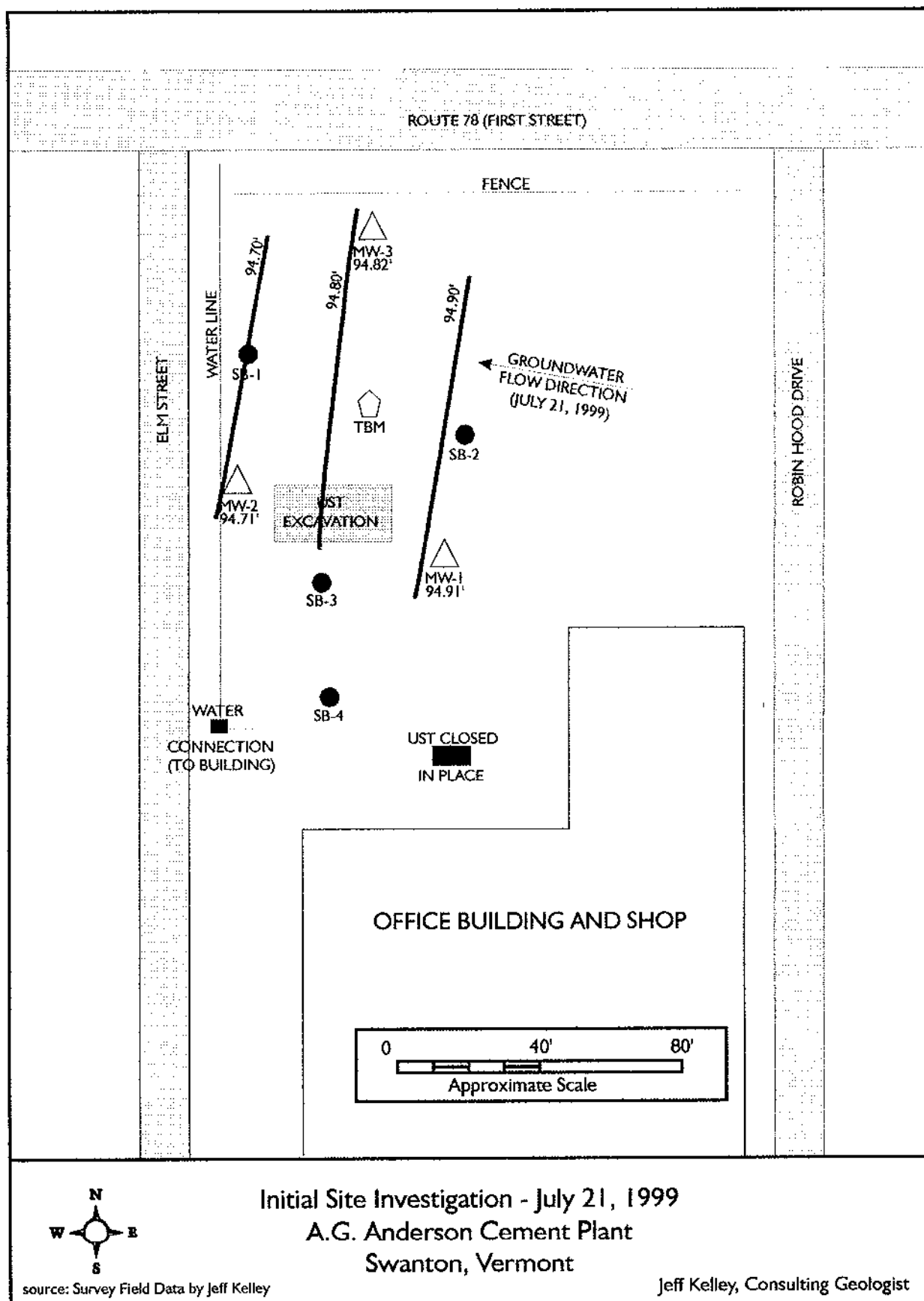
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September 7 1999



Location Map
A.G. Anderson Cement Plant
Swanton, Vermont

source: The VT Atlas and Gazetteer by DeLorme

Jeff Kelley, Consulting Geologist



GREEN MOUNTAIN LABORATORIES, INC.

27 Cross Road
Middlesex, Vermont 05602

Phone (802) 223 - 1468

Fax (802) 223 - 8688

LABORATORY RESULTS

CLIENT NAME:	Jeff Kelley	REFERENCE NO.:	5625
ADDRESS:	P.O. Box 9 Roxbury, VT 05669	PROJECT NO.:	NA
SAMPLE LOCATION:	Anderson - Swanton	DATE OF SAMPLE:	07/21/99
SAMPLER:	JK/KB	DATE OF RECEIPT:	07/22/99
ATTENTION:	Jeff Kelley	DATE OF ANALYSIS:	07/26/99 - 07/29/99
		DATE OF REPORT:	07/30/99

Pertaining to the analyses of specimens submitted under the accompanying chain of custody form, please note the following:

- Water samples submitted for analysis were preserved with HCl.
- Specimens were processed and examined according to the procedures outlined in the specified method.
- Holding times were honored.
- Instruments were appropriately tuned and calibrations were checked with the frequencies required in the specified method.
- Blank contamination was not observed at levels interfering with the analytical results.
- Continuing Calibration standards were monitored at intervals indicated in the specified method. The resulting analytical precision and accuracy were determined to be within method QA/QC acceptance limits.
- The efficiency of analyte recovery for individual samples was monitored by the addition of surrogate analyte to all samples, standards, and blanks. Surrogate recoveries were found to be within laboratory QA/QC acceptance limits, unless noted otherwise.

Reviewed by:



Sarah Hallock
Quality Assurance Officer

GREEN MOUNTAIN LABORATORIES, INC.

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LABORATORY RESULTS

GML REF. #: 5625
STATION: SB-1
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	1.4
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	7.5
m+p-Xylene	2	8.7
o-Xylene	1	1.7
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	ND

Surrogate % Recovery: 111 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. #: 5625
STATION: SB-2
ANALYSIS DATE: 07/26/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	ND
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	ND
m+p-Xylene	2	ND
o-Xylene	1	ND
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	ND

Surrogate % Recovery: 108 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. #: 5625
STATION: SB-3
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	ND
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	ND
m+p-Xylene	2	ND
o-Xylene	1	ND
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	23

Surrogate % Recovery: 105 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. # : 5625
STATION: SB-4
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	2	ND
Toluene	2	BPQL
Chlorobenzene	2	ND
Ethylbenzene	2	29
m+p-Xylene	4	44
o-Xylene	2	29
m-Dichlorobenzene	2	ND
p-Dichlorobenzene	2	ND
o-Dichlorobenzene	2	ND
MTBE	10	ND

Surrogate % Recovery: 112 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. # : 5625
STATION: SB-4
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: SOIL (83.1% DRY WEIGHT)

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/kg)	Conc. (µg/kg)
Benzene	110	ND
Toluene	110	ND
Chlorobenzene	110	ND
Ethylbenzene	110	ND
m+p-Xylene	220	ND
o-Xylene	110	ND
m-Dichlorobenzene	110	ND
p-Dichlorobenzene	110	ND
o-Dichlorobenzene	110	ND
MTBE	550	ND

Surrogate % Recovery: 112 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. # : 5625
STATION: MW-1
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	ND
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	ND
m+p-Xylene	2	ND
o-Xylene	1	ND
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	ND

Surrogate % Recovery: 109 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. #: 5625
STATION: MW-2
ANALYSIS DATE: 07/29/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	1.2
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	BPQL
m+p-Xylene	2	5.3
o-Xylene	1	1.1
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	ND

Surrogate % Recovery: 110 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. # : 5625
STATION: MW-3
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	ND
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	ND
m+p-Xylene	2	ND
o-Xylene	1	ND
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	ND

Surrogate % Recovery: 109 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

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LABORATORY RESULTS

GML REF. #: 5625
STATION: MW 3-A
ANALYSIS DATE: 07/27/99
DATE SAMPLED: 07/21/99
SAMPLE TYPE: WATER

GC/MS METHOD - EPA 8260M

PARAMETER	PQL (µg/L)	Conc. (µg/L)
Benzene	1	ND
Toluene	1	ND
Chlorobenzene	1	ND
Ethylbenzene	1	ND
m+p-Xylene	2	ND
o-Xylene	1	ND
m-Dichlorobenzene	1	ND
p-Dichlorobenzene	1	ND
o-Dichlorobenzene	1	ND
MTBE	5	ND

Surrogate % Recovery: 109 %

ND = Not Detected

BPQL = Below Practical Quantitation Limits

G M L S A M P L E #	Green Mountain Laboratories, Inc.						Analysis Requested								Page <u>1</u> of <u>1</u> GML # <u>5625</u>		
	27 Cross Road Middlesex, Vermont 05602 Phone (802) 223-1468 Fax (802) 223-8688 E-mail: GML@together.net																
	Client Name <u>Jeff Kelly</u>																
	Address <u>PO Box 9 Roxbury 05669</u>																
	Phone / Fax <u>485-7539</u>																
	Project Name <u>Anderson-Swanston</u>																
	Project Number																
	Project Manager <u>Jeff Kelly</u>																
	Sampler <u>JL/KB</u>																
	Sample Location	Date	Time	# of Cont.	Pres.	Sample Type											Remarks
1	SB-1	7-21-99	0953	2	HCL	Water	X	X									
2	SB-2		1020	2	HCL	Water	X	X									
3	SB-3		1100	2	HCL	Water	X	X									
4	SB-4		1615	2	HCL	Water	X	X									
5	SB-4		1603	2	NO	Soil	X	X									
6	MW-1		1350	2	HCL	Water	X	X									
7	MW-2		1500	2	HCL	Water	X	X									
8	MW-3		1605	2	HCL	Water	X	X									
9	MW 3-A	✓	1605	2	HCL	Water	X	X									
<div style="position: relative; width: 100%; height: 100%;"> Left blank JK 7-21-99 </div>																	

Chain of Custody

Relinquished By:	Date/Time: <u>7-22-99 8:30</u>	Received By:	Date/Time: <u>7/22/99 8:42</u>
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Temperature Blank:	Vial Lot ID #:		

Green Mountain Laboratories, Inc.

27 Cross Road

Middlesex, Vermont 05602

Phone: (802) 223-1468

Fax: (802) 223-8688

LABORATORY RESULTS

CLIENT NAME:	Jeff Kelley	GML REFERENCE #:	5625
CLIENT ADDRESS:	P.O. Box 9	PROJECT NO:	NA
	Roxbury, VT 05669	DATE OF SAMPLE:	07/21/99
SAMPLE LOCATION:	Anderson - Swanton	DATE OF RECEIPT:	07/22/99
SAMPLER:	JK/KB	DATE OF ANALYSIS:	07/26/99 - 07/29/99
ATTENTION:	Jeff Kelley	DATE OF REPORT:	07/30/99

Total Petroleum Hydrocarbons (TPH) by EPA Method 8015M (mg/L – ppm)

Sample	PQL	Result
SB-1	0.100	0.201
SB-2	0.100	<0.100
SB-3	0.100	<0.100
SB-4	0.200	0.555
MW-1	0.100	<0.100
MW-2	0.100	<0.100
MW-3	0.100	<0.100
MW 3-A	0.100	<0.100

PQL= Practical Quantitation Limit

Total Petroleum Hydrocarbons (TPH) by EPA Method 8015M (mg/kg – ppm)

Sample	% Dry Weight	PQL	Result
SB-4	83.1	11.0	<11.0

PQL= Practical Quantitation Limit

Reviewed by:



Sarah Hallock
Quality Assurance Officer

G M L S A M P L E #	Green Mountain Laboratories, Inc.						Analysis Requested								Page <u>1</u> of <u>1</u> GML # <u>5625</u>
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	E-mail: GML@together.net														
	Client Name <u>Jeff Kelly</u>														
	Address <u>PO Box 9 Roxbury 05669</u>														
	Phone / Fax <u>485-7539</u>														
	Project Name <u>Anderson-Swanston</u>														
	Project Number														
Project Manager <u>Jeff Kelly</u>															
Sampler <u>JL/KB</u>															
	Sample Location	Date	Time	# of Cont.	Pres.	Sample Type									Remarks
1	SB-1	7-21-99	0953	2	HCl	Water	X	X							
2	SB-2		1020	2	HCl	Water	X	X							
3	SB-3		1100	2	HCl	Water	X	X							
4	SB-4		1615	2	HCl	Water	X	X							
5	SB-4		1603	2	NO	Soil	X	X							
6	MW-1		1350	2	HCl	Water	X	X							
7	MW-2		1500	2	HCl	Water	X	X							
8	MW-3		1605	2	HCl	Water	X	X							
9	MW 3-A	↓	1605	2	HCl	Water	X	X							
<div style="display: flex; justify-content: space-between;"> Left Blank JL </div> <div style="text-align: center;">7-21-99</div>															

Chain of Custody

Relinquished By: <u>[Signature]</u>	Date/Time: <u>7-22-99 19:30</u>	Received By: <u>[Signature]</u>	Date/Time: <u>7/22/99 8:42</u>
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Temperature Blank:	Vial Lot ID #:		

A Simple Field Test for Subsurface Biodegradation

Draft 1 prepared July 28, 1997 by
John F. Amadon, CPSS

Introduction & Justification

Soil and groundwater contamination remains an issue within Vermont, the nation and our planet. While the perception, and even a regulatory definition of contamination will vary from individual to individual, the following discussion and field test centers on anthropogenic organic compounds in the subsurface. Such compounds include the conventional petroleum products of spilled gasoline and fuel oils, various organic wastes disposed through land based 'facilities', and even some of the synthetic halogenated organics that have become prevalent in our society.

A basic premise here is that all such 'organic' contaminants are amenable to insitu biodegradation where naturally occurring microorganisms within the soil and groundwater can metabolize or cometabolize the contaminants through a variety of pathways (Alexander, 1994; Chapelle, 1993; Salanitro, 1993; Paul & Clark, 1989). The rate of biodegradation, however, is generally not sufficiently rapid for adequate cleanup when sensitive receptors (basements, water supplies, surface waters, etc.) are adversely or potentially impacted by the contaminant(s). The Vermont Department of Environmental Conservation (VDEC, 1996) does recognize and encourage the use of natural bioattenuation or enhanced biodegradation where appropriate. The proposed field test will assist in defining those appropriate locations and situations. Further confirmation of biodegradation activity can be obtained during cursory review of the chromatographic patterns and characteristic peaks that are not routinely included in the standard analytical reports to VDEC (Amadon, 1996; Chaineau et al, 1996).

Biodegradation rates are often limited by a lack of subsurface oxygen which is generally utilized by the microorganisms as an ultimate electron acceptor in the enzymatic oxidation of the contaminant. There are, however, alternate electron acceptors that some microbes can utilize in lieu of oxygen (Amadon & Revell, 1995; Hutchins, et al. 1991; Lovley & Phillips, 1988). These include nitrate, oxides of manganese and iron, sulfate, and some of the organic metabolites themselves. From a mass perspective the most ubiquitous of these alternate electron acceptors within the natural subsurface is oxidized iron.

The presence of soluble iron within groundwaters is direct evidence of subsurface biological activity where dissolved oxygen has already been depleted. Concentrations of this reduced form of iron are often several orders of magnitude greater than groundwater quality standards within and hydraulically downgradient from an organic contaminant plume. Upon exposure to our atmosphere the reduced iron will be oxidized and precipitate out of solution as the orange 'rust' particles we often see within groundwater treatment systems or seeps from groundwater discharge areas. While conventional laboratory techniques can quantify concentrations of oxidized and/or reduced iron in an appropriately preserved sample, it can be more advantageous and cost effective to measure reduced iron levels onsite at the time of sampling. The following DIPY protocol has been found to be simple, inexpensive and to work well under all types of field conditions.

DIPY Field Test for Reduced Iron

The DIPY field procedure is taken from Bartlett and James (1995). DIPY is an acronym for 2,2'-dipyridyl (or α,α' -dipyridyl; or 2,2'-Bipyridine; $C_{10}H_8N_2$). 10 mM of reagent are buffered at Ph 4.8 in 1.25 M ammonium acetate (VT Soil Test Buffer 1) and stored in an amber glass dropping bottle. A few

drops of a water sample are placed in a well of a spotplate and a few drops of DIPY are added to the sample. The immediate development of a pink color will be readily apparent if reduced iron (Fe^{+2}) is present in the water sample.

The reaction is specific for Fe^{+2} and the intensity of the color is proportional to the Fe^{+2} concentration. Careful field control of sample and DIPY mix ratios, in comparison with comparable volumes (drops) of known standards can provide a relative indicator of sample Fe^{+2} concentration.

As briefly discussed above, the presence of Fe^{+2} is an indicator of biodegradation of subsurface organic compounds (native or anthropogenic). The simple, onsite, inexpensive DIPY field test could be a valuable tool in an overall assessment of contaminant biodegradation potential and/or conceptual design of a remedial corrective action plan.

References

- Alexander, M., 1994. Biodegradation and Bioremediation. Academic Press, Inc., San Diego, CA.
- Amadon, J.F., and S. Revell. 1995. Evaluation of Natural Biodegradation and Potential Stimulation Through Nitrate Addition to Groundwater. LAG report to the VDEC.
- Amadon, J.F. 1996. VDEC comment letters and unpublished data.
- Bartlett, R.J., and B.R. James. 1995. System for categorizing soil redox status by chemical field testing. Geoderma 68:211-218.
- Chaineau, C.H., J.L. Morel, and J. Oudot. 1996. Land Treatment of Oil-Based Cuttings in Agricultural Soil. J. Environ. Qual. 25:858-867.
- Chapelle, F., 1993. Ground Water Microbiology and Biochemistry. John Wiley & Sons, Inc. New York, NY.
- Hutchins, S.R., W.C. Downs, J.T. Wilson, C.B. Smith, D.A. Kovacs, D.D. Fine, R.H. Douglas, and D.J. Hendrix, 1991. Effect of Nitrate Addition on Bioremediation of a Fuel Contaminated Aquifer: Field Demonstration. Ground Water 29(4):571-580.
- Lovley, D.R. and E.J.P. Phillips, 1988. Novel Mode of Microbial Energy Metabolism: Organic Carbon Oxidation Coupled to Dissimilatory Reduction of Iron or Manganese. Applied Environ. Microbiol. 54(6):1472-1480.
- Paul, E.A. and F.E. Clark, 1989. Soil Microbiology and Biochemistry. Academic Press, Inc. San Diego, CA.
- Salanitro, J.P., 1993. The Role of Bioattenuation in the Management of Aromatic Hydrocarbon Plumes in Aquifers. Ground Water Monitoring Review, Fall, 1993.
- VDEC, 1996. Site Investigation Guidance Document. Vermont Agency of Natural Resources, Waste Management Division, Sites Management Section. Waterbury, VT.